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HUMAN ENGINEERING REPORT

UTILIZATION OF THE PHOTOGRAPHIC METHOD FOR DETERMINING BODY DIMENSIONS OF THE 95th PERCENTILE ARCTIC CLOTHED SOLDIER

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ARMY ROCKET AND GUIDED MISSILE AGENCY
U.S. ARMY ORDNANCE MISSILE COMMAND, REDSTONE ARSENAL, ALABAMA

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UTILIZATION OF THE PHOTOGRAPHIC METHOD FOR DETERMINING BODY DIMENSIONS OF THE 95TH PERCENTILE ARCTIC CLOTHED SOLDIER

by

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RESEARCH AND DEVELOPMENT OPERATIONS

Army Rocket and Guided Missile Agency

U. S. Army Ordnance Missile Command

ABSTRACT

This study was designed to test the concept of presenting the dimensions of the arctic clothed Soldier by means of photographs. Engineering personnel of the Army Rocket and Guided Missile Agency served as subjects to obtain measurements of the height and width from nine photographs of the 95th percentile arctic clothed Soldier. Measurements discrepancies among subjects and photographs were statistically significant, and lead to the conclusion that this particular method of presenting anthropometric data is neither valid nor reliable. Recommendations for presenting the required anthropometric data have been included.

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PREFACE

The Quartermaster Research and Development Center has attempted to solve the complex problem of translating the expression of human body dimensions from static to dynamic anthropometry by photographic techniques. This attempt to express the dimensions of the arctic clothed Soldier was a fresh approach and, to date, represents the best approximation for obtaining the needed information.

However, the measurement of an optically distorted two-dimensional representation of the three-dimensional dynamic human body results in errors that are unacceptable in missile system design. Therefore, this report is distributed in the hope that it will discourage, at this time, the use of the photographic technique for presenting anthropometric or other three-dimensional data where exact and accurate measurements are required. The designers of guided missile systems, as well as other military equipment, require accurate dimensions of the arctic clothed Soldier. Hence, other methods for presenting the data are needed.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

LIST OF ILLUSTRATIONS (Concluded)

*Figures are numbered and titled as they appeared in original report listed in reference 1.

UTILIZATION OF THE PHOTOGRAPHIC METHOD FOR DETERMINING BODY DIMENSIONS OF THE 95TH PERCENTILE ARCTIC CLOTHED SOLDIER

INTRODUCTION

In the design of equipment for use by U. S. Army personnel, prime consideration must be given to the environmental conditions under which the equipment will operate, and to its maximum utilization by those personnel. The equipment must be capable of functioning in a variety of climatic conditions if the Army is to be effective as a mobile striking force.

Equipment designed for the Army Ordnance Corps considers the size of 90 percent (5th through 95th percentile) of the user personnel. The arctic clothing required in severely cold climates makes design consideration essential of such factors as door height and width, crawl space, seating area, head room, or work space, so that even the 95th percentile Soldier will be accommodated. Since equipment designers must consider the 5th through 95th percentile arctic clothed Soldier, it is essential that the Army supply the necessary data on body dimensions. Existing anthropometric data are based on nude body measurements which requires an estimation as to how much larger the body dimensions will be when dressed in arctic clothing.

The need for more accurate data on the spatial dimensions of the arctic clothed Soldier was first discussed at the Army Human Engineering Conference held in September 1955. At this meeting the Quartermaster Research and Development Command agreed to accumulate the data and distribute it to the other technical services. In September 1956, the Environmental Protection Research Division of the Quartermaster Research and Development Center published a report (ref. 1) containing the required data in pictorial form.

Briefly, the following method was used by the Quartermaster Research and Development Center to accumulate the pictorial data on the 95th percentile arctic clothed Soldier. One subject, whose major body measurements equalled or exceeded those of the Army 95th percentile nude body measurement, was photographed while facing front, side, and rear for various poses. The subject was dressed in arctic clothing, with the exception of gloves. Arctic gloved hand dimensions are the subject of an additional report (ref. 2). Both the photographed subject and a related index scale, in inches and centimeters, appear on each photograph in the report.

The report states that the subject was positioned on the intersection of the centerline and baseline so that the two lines hypothetically would pass through the center planes of his body. The vertical height of the camera was always adjusted to be one-half the subject's height in each pose and at a distance of 12 feet. In this manner, according to the report, any dimension of the arctic clothed Soldier might be measured directly.

Dimensions of the 95th percentile Soldier depend upon the anthropometric reference data used. Table I indicates some of the differences found in published measurements of military personnel. The measurements of table I were selected at random from a number of sources, and are based on nude body measurements. Source references for the data of table I have been purposely omitted, but anthropometric references are included in the bibliography.

Whether the differences noted in table I are significant or not would depend on the statistical manipulations of the observed data. Nevertheless, differences do exist among the references, and equipment will be designed in terms of the particular reference available to the engineer.

Attempts to use the pictorial data of reference 1 to determine dimensions of the 95th percentile arctic clothed Soldier initiated this study. After measurement discrepancies were found between photographs, individuals selected at random were given the report containing the photographic method and requested to determine the standing height of the arctic clothed Soldier. The individual was permitted to select the photograph for measurement. Figures 1, 2, 7, 10 and 14 of the report were used by at least one individual during this preliminary phase of the investigation. On this basis, any of the figures 1 through 15, with the exception of figure 5, would have a chance of being selected from a large sample as the photograph used to determine the standing height of the 95th percentile arctic clothed Soldier.

This study was therefore designed specifically to determine the consistancy with which engineering personnel would obtain the dimensions of the 95th percentile arctic clothed Soldier by using the photographic method reported by the Quartermaster Research and Development Center. Based on the measurement discrepancies noted by the author in attemping to use the referenced report, the following hypotheses were established.

1. The photographic method of presenting anthropometric data of the arctic clothed Soldier is not valid. Validity implies that the method measures what it purports to measure.

2. The photographic method of presenting anthropometric data of the arctic clothed Soldier is not reliable. Reliability implies a repeatability of measurements on the same item.

PROCEDURE

Representative photographs selected from the report are listed below, with figure numbers and titles as used in the original report.

1. Figure 1. - Standing, front view, arms at sides

2. Figure 2. - Standing, side view, arms at sides

3. Figure 3. - Standing, rear view, arms at sides

4. Figure 10. - Standing, front view, arms behind back, palms to rear, sides of hands touching

5. Figure 12. - Standing, rear view, arms behind back, palms to rear, sides of hands touching

6. Figure 16. - Sitting, front view, knees and feet together, arms hanging, palms inward

7. Figure 34. - Kneeling on right knee, front view, right thigh and left calf parallel and vertical, arms outstretched horizontally, palms down

8. Figure 36. - Kneeling on right knee, rear view, right thigh and left calf paralleled and vertical, arms outstretched horizontally, palms down

9. Figure 37. - On hands and knees, front view, back horizontal, arms and thighs vertical and parallel

These photographs were removed from the main body of the report and presented one at a time to the subjects in the same order each time.

The subjects were requested to obtain measurements from the photograph of the height and widest portion of the Soldier, and to report the answer in inches to the nearest $\frac{1}{2}$ inch.

Sixteen civilian engineers employed by the Army at Redstone Arsenal were used as subjects in this study. Table II lists the

background of the subjects by degree, civil service grade, and years of engineering work experience.

The first six subjects of table II made five readings of the two measurements on each of the nine photographs. The five series of measurements were made on separate days, spread in some cases over a two-week period. The other ten subjects made one reading of the two measurements on the nine photographs.

The instructions to the subject were similar to those included in reference 1, and were given to the subject in written form. The instructions were:

"Using the dividers provided, determine:

1. The height of the man, including clothing, in inches.

2. The maximum width of the man, including clothing, in inches.

To obtain the measurements, bridge the desired dimensions with the dividers and transfer the dividers to the inch scale shown on the picture and read the actual size to the nearest $\frac{1}{2}$ inch. One precaution should be observed, since the depth effect in a photograph is produced by a progressive reduction inward from the foreground, an increasing, though slight discrepancy in actual size will occur as one takes measurements successively farther or nearer in depth from the plane described by the index scale. You are requested to be as accurate as possible."

Subjects were encouraged to ask questions concerning any portion of the instructions that were not clear.

Before the data from repeated trials by the first six subjects (group I) were analyzed, the additional ten subjects (group II) made one trial each. The data was set aside to be analyzed following analysis of group I data.

RESULTS

Analysis of variance, two-way classification and single classification were used to analyze the data where appropriate. The data are presented in terms of frequency distributions for the various photographs measured. Each subject's individual measurements for each photograph are included in this report with reproductions of the photographs used in this study.

Analysis of the standing measurement data of table III shows a significant difference among measurements of the photographs by the subjects, and a significant difference among the three photographs themselves. A significant difference exists between front and rear view photographs used for the width data of table IV, but range of measurements for either the front or rear view taken separately was not large enough to be significant among subjects. On these photographs, as well as the succeeding ones, the subjects' primary difficulty was determining the base line for placement of the divider point. Four subjects asked the data recorder for guidance in this matter, and were informed that they were to use their own judgement. Two subjects used a ruler to establish a constant base line. One subject of group I said he tried to locate the center of gravity at the base of the photograph to compensate for the depth effect. Midway through the fifth trial, another subject said a line drawn straight across from the base of the index scale on the side of the photograph would possibly establish the correct base line for measurement. When he had completed his trial he tested this theory and found no relationship from photograph to photograph for height.

Significant differences were found between photographs in height and width measurements for the standing pose, arms behind the back. The subjects differed significantly in height measurements only (see table V and VI).

Since a single photograph was used for the sitting pose (front view), only the data from group I were analyzed. These data (shown in tables VII and VIII), were significantly different among subjects for height measurements, but not for width. The group II data did not lend itself to analysis, but did substantiate the trend of the group I findings.

The height measurements of table IX (kneeling pose) indicated a significant difference among subjects, but not between photographs. However, it appears obvious from the data that some factor in the photographs caused the subjects to read consistantly high or low, with a decidedly noticeable gap between these extremes for the rear view photograph, and a less pronounced gap for the front view. The width data for the kneeling pose in table X were significantly different between photographs, but not among subjects.

A single photograph was used for the hands and knees pose (front view) in tables XI and XII. For both height and width, a significant difference in measurements were found among subjects of group I. Data of group II were not analyzed, but again substantiated the trend of data collected from group I.

DISCUSSION AND CONCLUSIONS

The measurement discrepancies among subjects and photographs during this study were significant in enough cases to support the hypotheses that this particular method of presenting anthropometric data is neither valid nor reliable (see table XIII).

VALIDITY

Significant differences were found in front and rear view height measurements for two of the three poses; the exception was the kneeling pose. It is apparent from the kneeling pose data of table IX that some factor, presumably the lack of a defined base line for measurement, caused the subjects to use two different base lines to measure the front and rear view. These differences caused bimodal measurement groupings around different points in each photograph. While these differences are not significant between the two photographs, the Army has approximately a 50/50 chance of having equipment designed either too small for the Soldier in question, or so large that needed space will be wasted. This space is especially vital in a mobile unit. In the data of table IX, some subjects estimated the Soldier's kneeling height as 56 inches, while others estimated his height as 60 inches. The width data were also significantly different for each of the three separate front and rear view poses. Identical measurements for comparable views of the same pose should be expected, if this particular method is valid.

RELIABILITY

Significant differences of the repeated measurements by group I subjects were found for the overall height of each series of photographs. Group II subjects did not make repeated measurements, and their results were not analyzed, but an examination of the data in tables III through XII substantiates the variation of measurements found in the group I data. An analysis of the width data indicated significant differences among subjects only for the hands and knees pose, but variations did exist. While not generally significant, these variations could well lead to equipment design that might prove difficult for the 95th percentile arctic clad Soldier to operate or utilize.

Although the photographic concept of presenting anthropometric data is in itself laudable, results of this study indicate that the present state of the art in optics possibly is not advanced enough for photographic presentation of anthropometric data.

Mobile guided missile systems, as well as other mobile forces, place stringent requirements for compactness on the design engineer. The engineer must therefore have accurate dimensions of the user personnel just as he must have dimensions of other components, if he is to meet requirements for equipment compactness. If a method of presenting data to a design engineer does not permit him to repeatedly obtain the same result for a given need, the method will soon be discarded, and it will be difficult to renew his faith in that particular method when the state of the art advances.

RECOMMENDATIONS

The unique poses in the report of the 95th percentile arctic clothed Soldier (ref. 1) should be preserved. However, for the sake of accuracy, it is recommended that Soldiers dressed in arctic clothing be measured in these poses in a laboratory situation and the data presented in tabular and pictorial form. Even then, these data should be brought up-to-date approximately every five years, since succeeding generations of the United States population seem to be growing larger. Some distortion of measurement will result from clothing compression by the measuring instrument. Other measurement errors will accrue as a result of body movement during the measuring process, but these errors will be infinitesimal compared to the variation of measurements found in this study.

TABLE I

PUBLISHED MEASUREMENTS OF THE 95TH PERCENTILE MAN FROM FOUR SOURCES
(in inches)

Body dimension	Source			
	W	X	Y	Z
Bi-deltoid	20.0	19.4	19.4	19.6
Hip breadth	16.3	15.4	15.4	12.9
Shoulder height	26.5	25.1	25.1	26.8
Eye height	31.6	33.5	33.5	33.5
Elbow to seat	10.5	11.5	10.8	11.0
Knee height	23.8	24.4	23.3	23.1
Chest thickness	11.0	10.4	---	9.6
Buttock to heel	---	46.7	46.1	44.0

TABLE II

BACKGROUND OF SUBJECT PERSONNEL

Subject	Number of measurements	College degree	Civil service grade	Years experience
1	5	EE	14	13
2	5	ME	13	18
3	5	CE	14	24
4	5	ME	14	15
5	5	ME	13	6
6	5	ME	13	37
7	1	EE	13	8
8	1	ME	12	6
9	1	CE	13	10
10	1	EE	12	5
11	1	ME	11	4
12	1	ME	14	17
13	1	ME	12	7
14	1	EE	9	3
15	1	ME	12	8
16	1	BS-MS	13	7

TABLE III

FREQUENCY DISTRIBUTION OF MEASUREMENT AND ANALYSIS OF VARIANCE FOR HEIGHT DATA, ARMS AT SIDE POSE, FRONT, SIDE AND REAR VIEW

Measured height, in.	Front view		Side view		Rear view	
	Subject groups		Subject groups		Subject groups	
	I	II	I	II	I	II
72.5						
73.0	1					
73.5			2		1	
74.0			4	2	1	
74.5	6	4	2	1		
75.0	9	4	4	4	3	1
75.5	1		3		4	1
76.0	8	1	9	2	1	1
76.5	5	1	6	1	4	3
77.0					2	
77.5					9	3
78.0					5	1
78.5						
Totals	30	10	30	10	30	10

Analysis of variance

Group I subjects

Source	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-ratio
Photos	30.02	2	15.01	28.98*
Subjects	66.63	5	13.33	25.73*
P X S	5.18	10	0.5180	1.57
Error	23.70	72	0.3292	
Totals	125.53	89		

Group II subjects

Photos	16.55	2	8.28	11.68†
Error	19.15	27	0.7090	
Totals	35.70	29		

*Significant at .001 level
†Significant at .005 level

TABLE IV

FREQUENCY DISTRIBUTION OF MEASUREMENT AND ANALYSIS OF VARIANCE FOR WIDTH DATA, ARMS AT SIDE POSE, FRONT AND REAR VIEW

Measured width, in.	Front view		Rear view	
	Subject groups		Subject groups	
	I	II	I	II
26.5				
27.0			1	1
27.5				
28.0				
28.5	2			
29.0	3	1		
29.5	19	6		
30.0	6	2		
30.5		1	2	
31.0			3	1
31.5			18	6
32.0			5	2
32.5				
33.0				
33.5				
34.0			1	
34.5				
Totals	30	10	30	10

Analysis of variance

Group I subjects

Source	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-ratio
Photos	56.07	1	56.07	70.44*
Subjects	3.70	5	0.740	0.93
P X S	3.98	5	0.796	1.69
Error	22.60	48	0.471	
Totals	86.35	59		

Analysis of variance

Group II subjects

Photos	11.25	1	11.25	11.88*
Error	17.05	18	0.947	
Totals	28.30	19		

*Significant at .001 level

TABLE V

FREQUENCY DISTRIBUTION OF MEASUREMENT AND ANALYSIS OF VARIANCE FOR HEIGHT DATA, ARMS BEHIND BACK POSE, FRONT AND REAR VIEW

Measured height, in.	Front view		Rear view	
	Subject groups		Subject groups	
	I	II	I	II
71.5				
72.0	1			
72.5	1	1		
73.0	11	4		
73.5	5	1		
74.0	10	2	1	
74.5	2	2	2	
75.0			9	2
75.5			1	1
76.0			10	4
76.5			7	3
77.0				
Totals	30	10	30	10

Analysis of variance

Group I subjects

Source	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-ratio
Photos	70.42	1	70.42	192.40*
Subjects	14.90	5	2.98	8.14†
P X S	1.83	5	0.366	1.91
Error	9.20	48	0.192	
Totals	96.35	59		

Group II subjects

Photos	30.02	1	30.02	81.58*
Error	6.62	18	0.368	
Totals	36.64	19		

*Significant at .001 level
†Significant at .05 level

TABLE VI

FREQUENCY DISTRIBUTION OF MEASUREMENT AND ANALYSIS OF VARIANCE FOR WIDTH DATA, ARMS BEHIND BACK POSE, FRONT AND REAR VIEW

Measured width, in.	Front view		Rear view	
	Subject groups		Subject groups	
	I	II	I	II
29.5				
30.0	4	1		
30.5	25	8		
31.0				
31.5	1	1		
32.0			2	
32.5				
33.0			6	4
33.5			20	6
34.0			2	
34.5				
Totals	30	10	30	10

Analysis of variance
Group I subjects

Source	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-ratio
Photos	123.27	1	123.27	501.09*
Subjects	1.00	5	0.20	0.81
P X S	1.23	5	0.246	2.18
Error	5.40	48	0.1125	
Totals	130.90	59		

Group II subjects

Photos	37.82	1	37.82	374.46*
Error	1.82	18	0.101	
Totals	39.64	19		

*Significant at .001 level

TABLE VII

FREQUENCY DISTRIBUTION OF MEASUREMENT AND ANALYSIS OF VARIANCE FOR HEIGHT DATA, SITTING POSE, FRONT VIEW

Measured height, in.	Front view	
	Subject groups	
	I	II
53.5		
54.0	1	
54.5		
55.0	6	1
55.5	1	
56.0	1	
56.5	1	1
57.0		1
57.5		
58.0	2	
58.5	2	1
59.0		
59.5	2	2
60.0	1	
60.5		1
61.0	12	3
61.5	1	
62.0		
Totals	30	10

Analysis of variance

Group I subjects

Source	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-ratio
Subjects	192.23	5	38.45	99.22*
Error	9.31	24	0.3875	
Totals	201.54	29		

*Significant at .001 level

TABLE VIII

FREQUENCY DISTRIBUTION OF MEASUREMENT AND ANALYSIS OF VARIANCE FOR WIDTH DATA, SITTING POSE, FRONT VIEW

Measured width, in.	Front view	
	Subject groups	
	I	II
29.5		
30.0	17	4
30.5	11	5
31.0	2	1
31.5		
Totals	30	10

Analysis of variance

Group I subjects

Source	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-ratio
Subjects	0.67	5	0.134	1.456
Error	2.20	24	0.092	
Totals	2.87	29		

TABLE IX

FREQUENCY DISTRIBUTION OF MEASUREMENT AND ANALYSIS OF VARIANCE FOR HEIGHT DATA, KNEELING POSE, FRONT AND REAR VIEW

Measured height, in.	Front view Subject groups		Rear view Subject groups	
	I	II	I	II
53.5				
54.0	1		1	1
54.5	1		1	
55.0	4	1	7	1
55.5			5	1
56.0	9	4	3	2
56.5	2			
57.0	1	1		
57.5				
58.0				
58.5		1		
59.0	1	1		
59.5	2	1		
60.0	8	1		
60.5	1		1	1
61.0			1	1
61.5			9	2
62.0			2	1
Totals	30	10	30	10

Analysis of variance

Group I subjects

Source	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-ratio
Photos	4.82	1	4.82	1.46
Subjects	319.85	5	63.97	19.38*
P X S	16.48	5	3.30	1.70
Error	93.00	48	1.94	
Totals	434.15	59		

Group II subjects

Photos	5.00	1	5.00	0.733
Error	122.70	18	6.82	
Totals	127.70	19		

*Significant at .005 level

TABLE X

FREQUENCY DISTRIBUTION OF MEASUREMENT AND ANALYSIS OF VARIANCE FOR WIDTH DATA, KNEELING POSE, FRONT AND REAR VIEW

Measured width, in.	Front view		Rear view	
	Subject groups		Subject groups	
	I	II	I	II
22.0				
22.5			2	
23.0				
23.5	1			
24.0				
24.5				
25.0			4	1
25.5			18	7
26.0			6	2
30.0	2			
30.5	2	1		
31.0	16	7		
31.5	9	1		
32.0				
32.5		1		
33.0				
Totals	30	10	30	10

Analysis of variance

Group I subjects

Source	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-ratio
Photos	448.26	1	448.26	317.92*
Subjects	10.98	5	2.20	1.56
P X S	0.89	5	0.18	.13
Error	67.60	48	1.41	
Totals	527.73	59		

Group II subjects

Photos	156.80	1	156.80	866.30*
Error	3.25	18	0.181	
Totals	160.05	19		

*Significant at .001 level

TABLE XI

FREQUENCY DISTRIBUTION OF MEASUREMENT AND ANALYSIS OF VARIANCE FOR HEIGHT DATA, HANDS AND KNEES POSE, FRONT VIEW

Measured height, in.	Front view	
	Subject groups	
	I	II
30.5		
31.0	1	
31.5	1	
32.0	1	
32.5		
33.0	1	
33.5		
34.0		
34.5		1
35.0		1
35.5	2	
36.0	2	1
36.5	1	
37.0	1	
37.5	1	
38.0	6	2
38.5	11	4
39.0	2	
39.5		
40.0		
40.5		1
41.0		
Totals	30	10

Analysis of variance

Group I subjects

Source	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-ratio
Subjects	108.77	5	21.754	11.83*
Error	44.20	24	1.84	
Totals	152.97	29		

*Significant at .001 level

TABLE XII

FREQUENCY DISTRIBUTION OF MEASUREMENT AND ANALYSIS OF VARIANCE FOR WIDTH DATA, HANDS AND KNEES POSE, FRONT VIEW

Measured width, in.	Front view	
	Subject groups	
	I	II
25.5		
26.0	3	1
26.5	1	2
27.0	23	6
27.5	3	1
28.0		
Totals	30	10

Analysis of variance

Group I subjects

Source	Sum of squares (SS)	Degrees of freedom (df)	Mean square (MS)	F-ratio
Subjects	1.97	5	0.394	4.98*
Error	1.90	24	0.079	
Totals	3.87	29		

*Significant at .005 level

TABLE XIII

INDIVIDUAL MEASUREMENTS IN INCHES BY ALL SUBJECTS FOR EACH PHOTOGRAPH

SUBJECT NUMBER	PHOTOGRAPH NUMBER 1		2		3		10		12		16		34		36		37	
	ht.*	W.*	ht.	W.	ht.	W.	ht.	W.	ht.	W.	ht.	W.	ht.	W.	ht.	W.	ht.	W.
1	74.5	29.5	76.0	22.0	75.5	31.5	72.5	30.0	76.0	33.5	59.5	30.0	55.0	31.0	55.0	25.5	38.0	27.0
	74.5	29.5	76.0	22.0	77.5	31.5	72.0	30.5	76.0	33.5	59.5	30.0	56.0	30.5	55.0	25.5	38.5	27.0
	76.5	30.0	76.0	22.0	77.5	27.5	74.0	30.5	76.0	33.5	61.0	30.0	60.0	31.0	62.0	26.0	38.5	27.0
	76.0	29.5	76.0	22.0	77.5	31.5	74.0	30.5	76.0	33.5	61.0	30.5	59.5	31.5	61.5	25.5	38.5	27.0
	76.5	30.0	76.5	22.0	78.0	31.5	73.5	30.5	76.5	33.5	61.0	30.5	60.0	31.5	61.5	26.0	38.5	27.0
2	74.5	29.5	74.0	22.0	75.5	31.5	73.5	30.5	75.0	32.0	55.0	30.0	56.0	30.5	55.5	25.0	39.0	27.0
	74.5	28.5	74.0	21.5	73.5	30.5	73.0	30.5	74.0	34.0	55.0	30.0	56.0	31.0	56.0	25.5	38.5	26.5
	75.0	29.5	73.5	21.5	76.0	32.0	73.0	30.5	75.5	33.0	55.0	30.0	57.0	31.0	56.0	25.0	39.0	27.0
	74.5	29.0	73.5	21.5	75.5	31.5	73.0	30.5	75.0	33.5	55.5	30.5	56.0	31.0	56.0	25.5	35.5	27.0
	75.0	29.5	74.0	22.0	75.5	34.0	73.0	30.5	75.0	33.5	56.6	30.0	56.0	31.0	55.0	25.5	37.0	27.0
3	76.5	30.0	76.5	22.5	78.0	32.0	74.5	30.5	76.5	33.5	61.0	30.5	60.0	23.5	61.5	22.5	38.5	27.0
	76.5	30.0	76.5	22.0	78.0	31.5	74.0	30.5	76.5	33.5	61.0	30.5	60.5	31.5	61.5	25.5	38.0	27.0
	76.0	30.0	76.5	22.0	78.0	32.0	74.0	30.5	76.5	34.0	61.5	30.5	60.0	31.5	61.5	25.5	38.0	27.0
	76.5	30.0	76.5	22.5	78.0	32.0	74.5	30.5	76.5	33.5	61.0	30.5	60.0	31.5	61.5	22.5	38.0	27.0
	76.0	29.5	76.5	22.0	77.5	32.0	74.0	30.5	76.0	33.5	61.0	30.5	60.0	31.5	62.0	26.0	38.0	27.0
4	75.0	29.5	75.5	21.5	77.5	31.5	73.5	30.5	76.5	33.5	60.0	30.5	56.0	31.0	55.0	25.5	37.5	27.5
	75.5	29.5	75.0	22.0	76.5	31.5	73.5	30.5	75.0	33.5	58.5	30.0	55.0	31.0	55.5	25.5	35.5	27.0
	75.0	29.5	75.5	21.5	76.5	31.5	73.5	30.5	75.0	33.5	58.0	30.0	56.0	31.0	55.0	25.5	36.5	27.0
	75.0	28.5	75.0	21.5	76.5	31.5	73.0	30.5	75.0	33.5	58.0	30.0	56.0	31.0	55.5	25.5	36.0	27.0
	75.0	29.5	75.0	22.0	76.5	31.5	73.0	30.5	75.0	33.5	58.5	30.0	56.5	31.0	55.5	25.5	36.0	27.0
5	76.0	29.5	76.0	21.5	77.5	31.5	74.0	30.5	76.0	33.0	61.0	30.0	56.5	31.5	61.5	25.5	38.5	27.0
	76.0	29.5	76.0	21.5	77.5	31.5	74.0	30.5	76.0	33.5	61.0	30.0	59.0	31.5	61.5	25.5	38.5	27.5
	76.0	29.5	76.0	21.5	77.5	31.5	74.0	30.5	76.5	33.5	61.0	30.5	60.0	31.0	61.5	25.5	38.5	27.0
	76.0	29.5	76.0	22.0	77.0	31.5	74.0	30.5	76.0	33.5	61.0	30.0	59.5	31.0	60.5	25.5	38.5	27.5
	76.0	29.5	76.0	21.5	77.5	31.5	74.0	30.0	76.0	33.5	61.0	30.5	60.0	31.5	61.0	25.5	38.5	27.0
6	75.0	29.5	75.5	21.5	77.0	31.5	73.0	30.5	76.0	33.0	55.0	30.0	55.0	31.0	55.0	25.0	38.0	27.0
	75.0	29.5	74.0	21.5	74.0	31.0	73.0	31.5	75.0	33.0	54.0	31.0	54.5	30.0	54.0	26.0	31.5	26.0
	75.0	29.0	74.5	21.0	75.0	31.0	73.0	30.0	74.5	32.0	56.0	30.0	55.0	31.0	54.5	25.0	32.0	27.0
	74.5	29.5	75.0	21.5	75.0	30.5	73.0	30.0	74.5	33.0	55.0	30.0	54.0	31.0	55.0	26.0	33.0	26.0
	73.0	29.0	74.5	21.5	75.0	31.0	73.0	30.5	75.0	33.0	55.0	31.0	56.0	30.0	55.5	26.0	31.0	26.0

*Abbreviations - ht. Height
- W. Width

TABLE XIII (Concluded)

INDIVIDUAL MEASUREMENTS IN INCHES BY ALL SUBJECTS FOR EACH PHOTOGRAPH

SUBJECT NUMBER	PHOTOGRAPH NUMBER 1		2		3		10		12		16		34		36		37	
	ht.*	W.*	ht.	W.	ht.	W.	ht.	W.	ht.	W.	ht.	W.	ht.	W.	ht.	W.	ht.	W.
7	74.5	29.5	76.0	22.0	75.5	31.5	73.0	30.5	75.0	33.0	55.0	31.0	60.0	32.5	56.0	25.0	38.5	27.0
8	74.5	29.0	76.5	22.0	76.5	31.5	74.0	30.5	76.0	33.0	56.5	30.0	55.0	31.0	55.5	25.5	38.5	27.0
9	76.0	29.5	74.0	21.5	77.5	27.5	73.0	30.5	76.5	33.5	59.5	30.0	56.0	31.0	54.0	26.0	38.0	27.0
10	76.5	30.0	74.0	22.0	77.5	31.5	73.0	30.0	75.0	33.5	61.0	30.5	56.0	30.5	61.5	25.5	38.5	26.5
11	75.0	29.5	75.0	22.0	78.0	32.0	74.0	30.5	76.5	33.5	61.5	30.5	59.0	31.5	62.0	26.0	38.0	27.0
12	75.0	29.5	76.0	22.0	75.0	31.0	74.5	30.5	75.5	33.0	58.5	30.0	56.0	31.0	61.5	25.5	36.0	27.0
13	75.0	29.5	75.0	22.0	76.5	31.5	72.5	31.5	76.0	33.5	61.0	30.5	57.0	31.0	55.0	25.5	34.5	26.0
14	74.5	30.5	75.0	22.0	77.5	32.0	74.0	30.5	76.0	33.5	57.0	30.5	59.5	31.0	61.0	25.5	38.5	27.5
15	74.5	30.0	75.0	22.0	76.0	31.5	73.5	30.5	76.5	33.0	60.5	30.5	58.5	31.0	60.5	25.5	35.0	26.5
16	75.0	29.5	74.5	21.5	76.5	31.5	73.0	30.5	76.0	33.5	59.5	30.0	56.0	31.0	56.0	25.5	40.5	27.0

*Abbreviations - ht. Height
- W. Width

Figure 1. - Standing, arms at sides – front view.

Figure 2. - Standing, arms at sides – side view.

B1 Delford - 19.6 in (nude)
* 25.5 in (clothed

Figure 3. - Standing, arms at sides – rear view.

Figure 10. - Standing, arms behind back, palms to rear, sides of hands touching – front view.

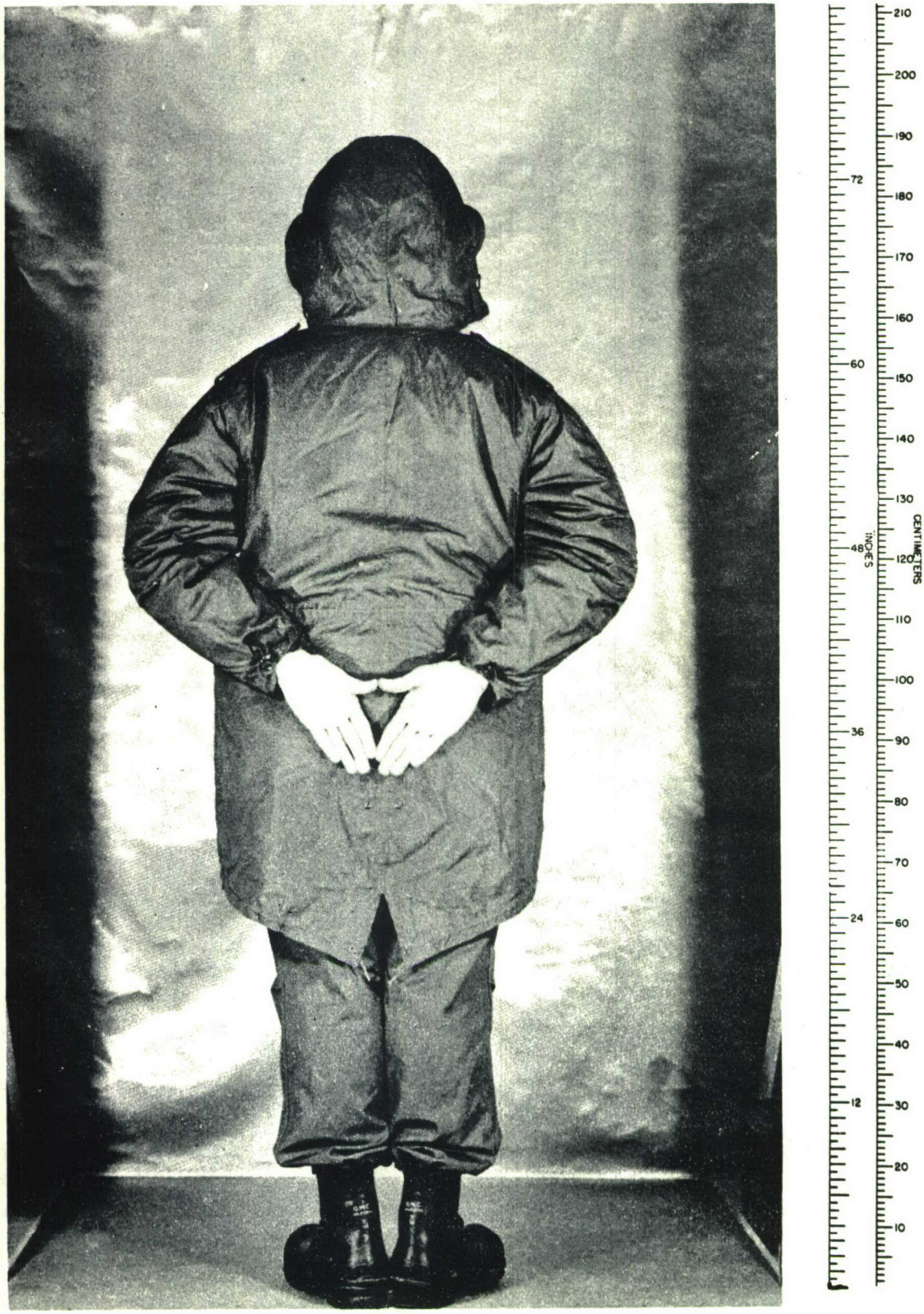

Figure 12. - Standing, arms behind back, palms to rear, sides of hands touching - rear view.

Figure 16. - Sitting, knees and feet together, arms hanging, palms inward – front view.

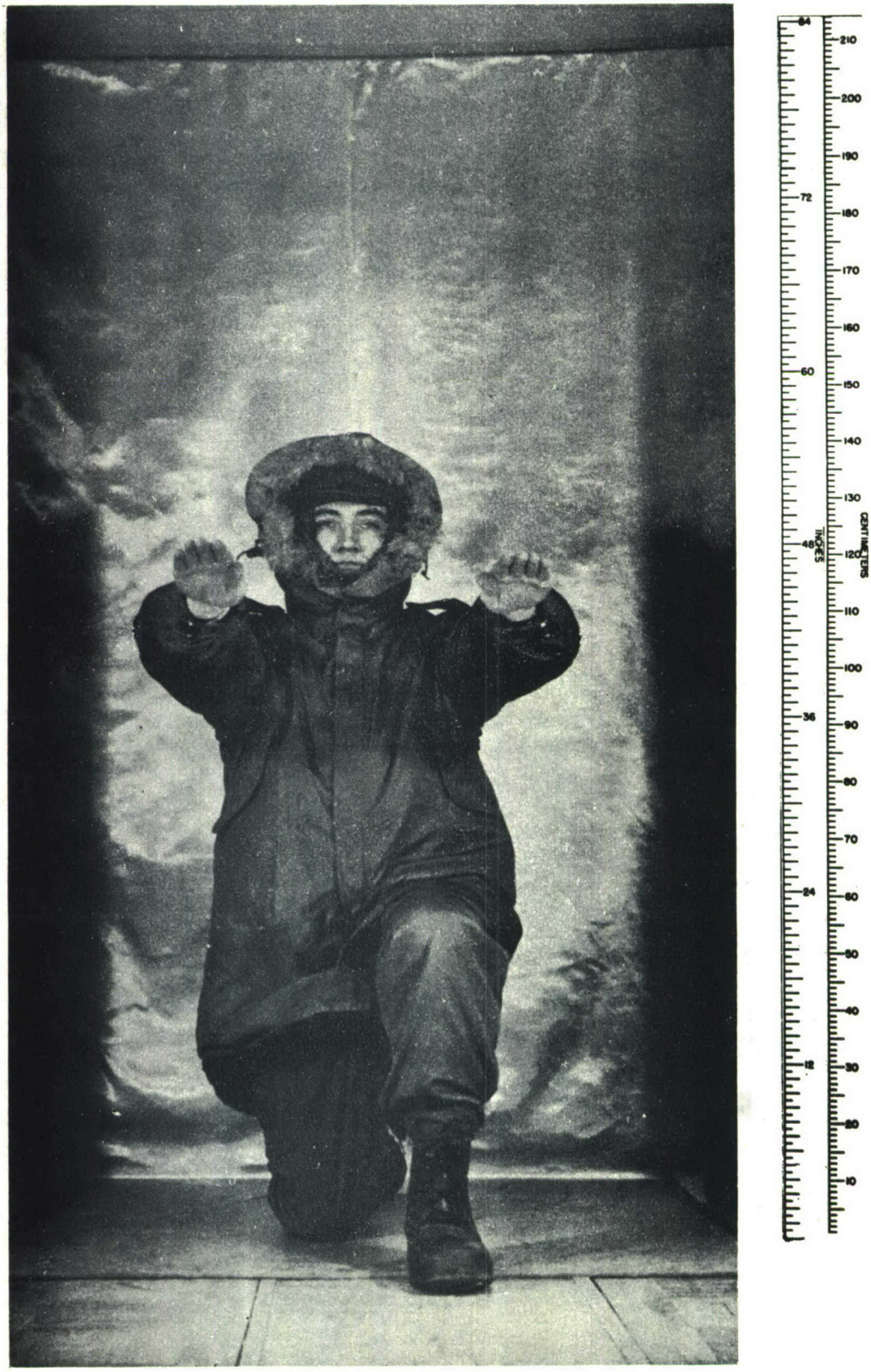

Figure 34. - Kneeling on right knee, right thigh and left calf parallel and vertical, back vertical, arms outstretched horizontally, palms down - front view.

Figure 36. - Kneeling on right knee, right thigh and left calf parallel and vertical, back vertical, arms outstretched horizontally, palms down – rear view.

Figure 37. - On hands and knees, back horizontal, arms and thighs vertical and parallel – front view.

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